SynSigGAN: Generative Adversarial Networks for Synthetic Biomedical Signal Generation

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Abstract

Simple Summary This paper proposes a novel generative adversarial networks model, SynSigGAN, to generate any kind of synthetic biomedical signals. The generation of synthetic signals eliminates confidentiality concerns and accessibility problem of medical data. Synthetic data can be utilized for training medical students and machine learning models for the advancement and automation of healthcare systems. Our proposed model performs significantly better than existing models with a high correlation coefficient that measures the generated synthetic signals' similarity with the original signals. Abstract Automating medical diagnosis and training medical students with real-life situations requires the accumulation of large dataset variants covering all aspects of a patient's condition. For preventing the misuse of patient's private information, datasets are not always publicly available. There is a need to generate synthetic data that can be trained for the advancement of public healthcare without intruding on patient's confidentiality. Currently, rules for generating synthetic data are predefined and they require expert intervention, which limits the types and amount of synthetic data. In this paper, we propose a novel generative adversarial networks (GAN) model, named SynSigGAN, for automating the generation of any kind of synthetic biomedical signals. We have used bidirectional grid long short-term memory for the generator network and convolutional neural network for the discriminator network of the GAN model. Our model can be applied in order to create new biomedical synthetic signals while using a small size of the original signal dataset. We have experimented with our model for generating synthetic signals for four kinds of biomedical signals (electrocardiogram (ECG), electroencephalogram (EEG), electromyography (EMG), photoplethysmography (PPG)). The performance of our model is superior wheen compared to other traditional models and GAN models, as depicted by the evaluation metric. Synthetic biomedical signals generated by our approach have been tested while using other models that could classify each signal significantly with high accuracy.